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Ultrasound-Guided Percutaneous Aortic Aneurysm Repair can be Performed Safely With High Success and Improved Rates of Local Wound Complications

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Introduction and objectives: Ultrasound-guided access allows for direct visualization of the access artery during percutaneous endovascular aneurysm repair (EVAR). We hypothesize that the use of ultrasound guidance allowed us to safely increase the use of percutaneous EVAR and to benefit from its lower rates of wound complications.

Methods: A retrospective record review was performed of all elective EVAR from 2005 to 2010 at an academic tertiary care center. Patients were identified using International Classification of Diseases, 9th Revision, Clinical Modification codes and stratified by percutaneous vs femoral cutdown access. We examined the success rate of percutaneous access and the cause of failure. Sheath size was large (≥16F) or small (<16F). Outcomes were wound complications (infections or clinically significant hematomas), operative time, length of stay, and discharge disposition. Predictors of percutaneous failure and femoral cutdown access were determined.

Results: Percutaneous access was used in 141 patients (281 arteries) and femoral cutdown in 104 patients (208 arteries). Ultrasound-guided access was introduced in 2006. Percutaneous access increased from 0% in 2005 to 92.9% of elective EVAR in 2010. The remaining 7% had planned cutdown for concomitant femoral-femoral bypass. The success rate with percutaneous access was 95.1%. Failures included hemorrhage in eight and occlusion of the artery in five. Percutaneous access had fewer wound complications (0% vs 7.6%, $P \leq .01$) and shorter operative time (157.6 vs 207.5 minutes, $P \leq .001$). Length of stay (3.2 vs 4.1 days, $P = .09$) and discharge home (91.5% vs 84.3%, $P = .08$) had trends towards significance. No difference was seen in body mass index (26.6 vs 26.8 kg/m^2, $P = .73$). There were no predictors of femoral cutdown access. Only peripheral arterial disease predicted percutaneous failure (odds ratio, 4.59; 95% confidence interval, 1.27-15.57; $P = .025$).

Conclusions: Ultrasound guidance has prompted the increased use of percutaneous EVAR in nearly all elective EVAR cases. Percutaneous access has fewer wound complications and shorter operative time and can be performed safely with a high success rate.

Long-term Durability of Open Repair of Juxtarenal Abdominal Aortic Aneurysms: A Performance Standard for Fenestrated and Branched Endovascular Aneurysm Repair

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Introduction and objectives: As use of branched and fenestrated endografts expands, surgical options for juxtarenal abdominal aortic aneurysms (JAAA), long-term durability will be compared with that of open JAAA repair, which has not been documented in large contemporary series. The goal of this study was to assess the late clinical and anatomic outcomes after open JAAA repair.

Methods: From July 2001 to December 2007, 229 patients underwent open JAAA repair with suprarenal clamping. End points included perioperative and late survival, long-term follow-up of renal function, and freedom from graft-related complications. Factors predictive of survival were determined by multivariate analysis.

Results: Patients were a mean age of 75 years, 71% were male, 21% had baseline renal insufficiency (creatinine >1.5 mg/dL), and 11% had a contained or free rupture. Forty-five renal artery bypasses were performed in 43 patients. The 30-day mortality was 5.6% (2.5% in nonruptured). Six patients (2.6%) required early dialysis, and two had recovered by discharge. Two additional patients progressed to dialysis over time. There was one graft infection involving one limb of a bifurcated graft. Surveillance imaging was obtained in 115 patients (78% of survivors) at a mean follow-up of 40 ± 28 months. Renal artery occlusion occurred in five patients (2 native and 3 grafts). Two patients (1.8%) had aneurysmal degeneration of the aorta at the anastomosis, but there were no pseudoaneurysms. Remote aneurysms were found in 29 patients (27%), 19 of whom had descending thoracic or thoracoabdominal aneurysms (TAA). Four patients underwent subsequent thoracic endovascular aneurysm repair. Actuarial survival was 68R ± 3.3% at 5 years. Negative predictors of survival were age (RR, 1.04; $P = .02$), smoking (RR, 1.37; $P = .01$), elevated preoperative creatinine (RR, 1.56; $P = .04$), and a late rising creatinine (RR, 1.84; $P < .001$).

Conclusions: Open JAAA repair yields excellent long-term anatomic durability and preserves renal function. Although graft-related complications are rare (<2% at 40 months), axial imaging revealed TAA in 17% of patients, making continued surveillance for remote aneurysms prudent. These data provide a benchmark against which complex endovascular aneurysm repair can be compared.

Influence of Establishment of a Protocol for Endovascular Repair in Ruptured Abdominal Aortic Aneurysm in Patient Outcomes

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Introduction and objectives: Ruptured abdominal aortic aneurysm (RAAA) continues to carry a high mortality. A randomized trial and a few single-center experiences have shown improved short-term results with endovascular aneurysm repair (EVAR) compared with open repair of RAAA. An EVAR for RAAA (R-EVAR) program was started in 2007 at our institute. We studied our own experience with repair of RAAA during 10-year period, comparing outcomes between the two time periods.

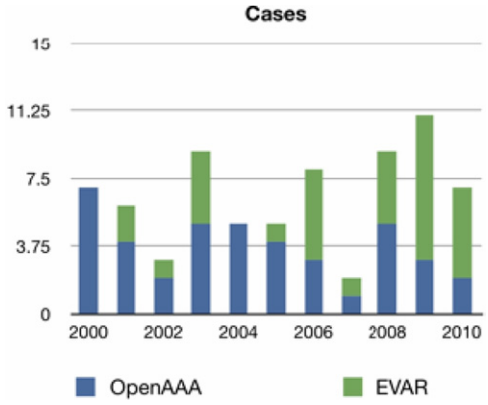

Fig. Annual number of ruptured AAA cases per year.

Methods: A retrospective review of patient records was performed. Consecutive patients who underwent emergency repair of RAAA between October 2000 and September 2010 were identified. The R-EVAR program was started in 2007 with principles being permissive hypotension, awake femoral artery cutdown, and balloon control if needed with EVAR, if feasible. All patients with systolic blood pressure >80 mm Hg underwent computed tomography angiography. Data were collected regarding patient demographics, risk factors, and outcomes, including death, hospital length of stay, and discharge status.

Results: We identified 72 patients (82% men) with RAAA repair. Average age was 70 years. Overall mortality was 32%, and has remained relatively stable over time. The trend over the course of time revealed more cases being selected for EVAR rather than open repair (Fig). Subgroup analysis comparing cases done before and after year 2007 showed lower mortality (40% vs 21%) and a relatively higher proportion of patients being discharged to home in the later time period. The readmission and reintervention rates remained <1% in both groups.

Conclusions: More patients were being selected for EVAR than for open repair over time. The mortality rate was reduced from 40% to 20% amongst all the patients once a standardized protocol was introduced.

Impact of Chronic Kidney Disease on Outcomes After Abdominal Aortic Aneurysm Repair

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Introduction and objectives: Chronic kidney disease (CKD) is associated with increased morbidity and death after open abdominal aortic aneurysm (AAA) repair (OAR). This study highlights the effect of CKD on outcomes after endovascular AAA repair (EVAR) and OAR in contemporary practice.

Methods: The National Surgical Quality Improvement Program Participant Use File (2005-2008) was queried by Current Procedural Terminology code to identify EVAR or OAR patients who were grouped by CKD class as having mild (class 1, 2), moderate (class 3), or severe (class 4, 5) renal disease. Comparative analysis of mortality and clinical outcomes was performed based on CKD strata.

Results: CKD increased ($P < .01$) overall mortality with rates of 1.7% (mild), 5.3% (moderate), and 7.7% (severe) in unmatched patients. Rates in severe patients were as high as 6.2% for EVAR and 10.3% for OAR. Propensity matching to control for comorbidities was performed, resulting in similar baseline clinical and demographic features of patients with mild compared to those with moderate or severe disease. Even in matched cohorts, moderate and severe CKD increased the risk of 30-day mortality and complications compared with mild OAR and EVAR patients (Table I). On regression analysis, moderate and severe CKD independently predicted operative mortality and complications (Table II).

Conclusions: The presence of moderate or severe CKD in patients considered for AAA repair is associated with significantly increased mortality and therefore should figure prominently in clinical decision making.

Table I. Thirty-day outcomes in propensity-matched open repair (*OAR*) and endovascular aneurysm repair (*EVAR*) patients by degree of chronic kidney disease (*CKD*)

	30-day mortality (%)		*Any complication (%)*	
CKD degree	*EVAR*	*OAR*	*EVAR*	*OAR*
Mild	1.9	3.1	3.1	11
Moderate	3.2[a]	8.4[a]	8.4[a]	32[a]
Severe	5.7[a]	9.9[a]	9.9[a]	25[a]

[a]$P \leq .01$ compared with mild CKD.

Table II. Chronic kidney disease (*CKD*) independently predicts mortality and complication risk

	30-day mortality		*Any complication*	
	OR (95% CI)		*OR (95% CI)*	
CKD degree	*EVAR*	*OAR*	*EVAR*	*OAR*
Moderate	1.7 (1.1-2.7)[a]	2.8 (1.8-4.5)[a]	1.6 (1.3-2.0)[a]	1.4 (1.2-1.8)[a]
Severe	1.5 (1.1-2.1)[a]	1.6 (1.1-2.3)[a]	1.4 (1.2-1.7)[a]	1.2 (1.01-1.4)[a]

CI, Confidence interval; *EVAR,* endovascular aneurysm repair; *OAR,* open aneurysm repair; *OR* odds ratio.
[a]$P \leq .05$ compared with mild.

Utility of a Standardized Measurement Protocol to Simplify Case Planning for Branched-Fenestrated Endovascular Aortic Aneurysm Repair

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Introduction and objectives: Standardization of branch vessel measurement for branched-fenestrated endovascular aortic aneurysm repair could simplify the teaching of patient selection, case planning, and device selection. The purpose of this study was to determine (1) the accuracy of measurements obtained by a novice nonclinician using a standardized computer-aided protocol, and (2) interobserver variability between an experienced clinician and a clinical fellow.

Methods: Computed tomography angiographies from 60 patients with 239 visceral branches of thoracoabdominal aortic aneurysms were examined by three observers: a technologist using a novel computer-aided standardized protocol, a trained clinical fellow, and a vascular surgeon experienced in branched endograft repair. Measurements included centerline distance between vessels, branch angle, lumen diameter, and the resulting arc length for placement of the fenestration-branch origin. Interobserver variability was measured by Bland-Altman method.

Results: Measurements obtained by the standard algorithm closely matched those of experienced clinicians, with 99% of arc length measurements ≤4 mm and 96% ≤3 mm. Two arc length measurements (0.8%) exceeded the 4-mm threshold: one due to scatter artifact and one due to extreme angulation. Arc length mean error was −0.1 mm (95% limits of agreement, −3.0 to 2.8 mm), and accuracy was not related to the arc length. The interobserver comparison between clinicians found 96% agreement ≤4 mm.

Conclusions: This standardized protocol demonstrated excellent reliability, even when performed by a novice and when compared with nonstandardized measurements by experienced clinicians. Although it represents only a portion of case planning, this branch measurement protocol is simple and can be rapidly taught using workstations that already exist in most hospitals. We believe it will simplify the teaching of patient selection, case planning, and device selection for branched fenestrated endovascular aneurysm repair.

Variation in Thromboembolic Complications Among Patients Undergoing Commonly Performed Cancer Operations

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Introduction and objectives: There is widespread evidence that cancer confers an increased risk of deep venous thrombosis (DVT). This risk is thought to vary among different cancer types. The purpose of this study was to better define the incidence of thrombotic complications among patients undergoing surgical treatment for a spectrum of prevalent cancer diagnoses in contemporary practice.

Methods: All patients undergoing one of ten cancer surgical operations (breast surgery, hysterectomy, prostatectomy, colectomy, gastrectomy, lung resection, hepatectomy, pancreatectomy, cystectomy, and esophagectomy) were identified by Current Procedural Terminology and International Classification of Diseases, 9th Revision, Clinical Modification codes using the National Surgical Quality Improvement Program (NSQIP). The primary end point was perioperative DVT. Secondary end points included pulmonary embolism (PE) and overall venous thromboembolic events (VTE) ≤1 month of the index procedure. Multivariate logistic regression was used to calculate adjusted odds ratios for the primary end point.

Results: During the study interval (2007-2009), 42,842 of the selected cancer operations were performed. The incidence of DVT, PE and total VTE ≤1 month after surgery varied widely across a spectrum of cancer diagnoses, from 0.19%, 0.12%, and 0.28% for breast resection to 6.1%, 2.4%, and 7.3%, respectively, for esophagectomy. Compared with breast cancer, the incidence of thrombotic complications ranged from a 2.4-fold increase in DVT associated with lung resection (95% confidence interval, 1.2-4.9, $P = .017$) to a 6.1-fold increase associated with esophagectomy (95% confidence interval, 3.3-11.4; $P < .001$; Table).

Conclusions: The incidence of DVT and thrombotic complications associated with cancer surgery varies substantially. These findings suggest that tumor type and resection magnitude may both affect VTE risk. Accordingly, such data can be used to anticipate risk of potentially preventable morbid complications.

Table. Incidence rates and odds ratios (*OR*) of venous thromboembolism (*VTE*) among commonly performed cancer operations[a]

	Rate (per 1000 cases)		*OR (95% CI) Adjusted for DVT*[a]	
Operation	*DVT, % (No.)*	*VTE, % (N)*		P
Breast	1.9 (15)	2.8 (22)	1.0 (ref)	
Lung resection	12.8 (18)	23.4 (33)	2.4 (1.2-4.9)	.017
Prostatectomy	7.4 (22)	12.1 (36)	2.5 (1.3-5)	.008
Gastrectomy	17.9 (42)	26.9 (63)	2.6 (1.4-4.8)	.003
Pancreatectomy	22.7 (125)	34.1 (188)	2.6 (1.4-4.6)	.001
Hepatectomy	19.1 (71)	29.9 (111)	2.9 (1.6-5.3)	<.001
Cystectomy	27.7 (9)	46.2 (15)	2.9 (1.6-5.3)	.019
Hysterectomy	11 (18)	17.8 (29)	3.5 (1.8-7.2)	<.001
Colectomy	16.6 (267)	24.5 (394)	3.5 (2-5.8)	<.001
Esophagectomy	60.6 (65)	72.8 (78)	6.1 (3.3-11.4)	<.001

CI, Confidence interval; *DVT,* deep vein thrombosis.
Data derived from National Surgical Quality Improvement Program (2007-2009).
[a]Odds ratio adjusted for patient characteristics and preoperative, intraoperative, and postoperative factors.

Initial Use of a Large-Bore Suction Thrombectomy Cannula For the Treament of Massive Inferior Vena Cava and Iliofemoral Deep Venous Thrombosis

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